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# USA SCT Barrel Module Assembly

SCT Week CERN  
December 2003

Presented by Abe Seiden  
U.C. Santa Cruz

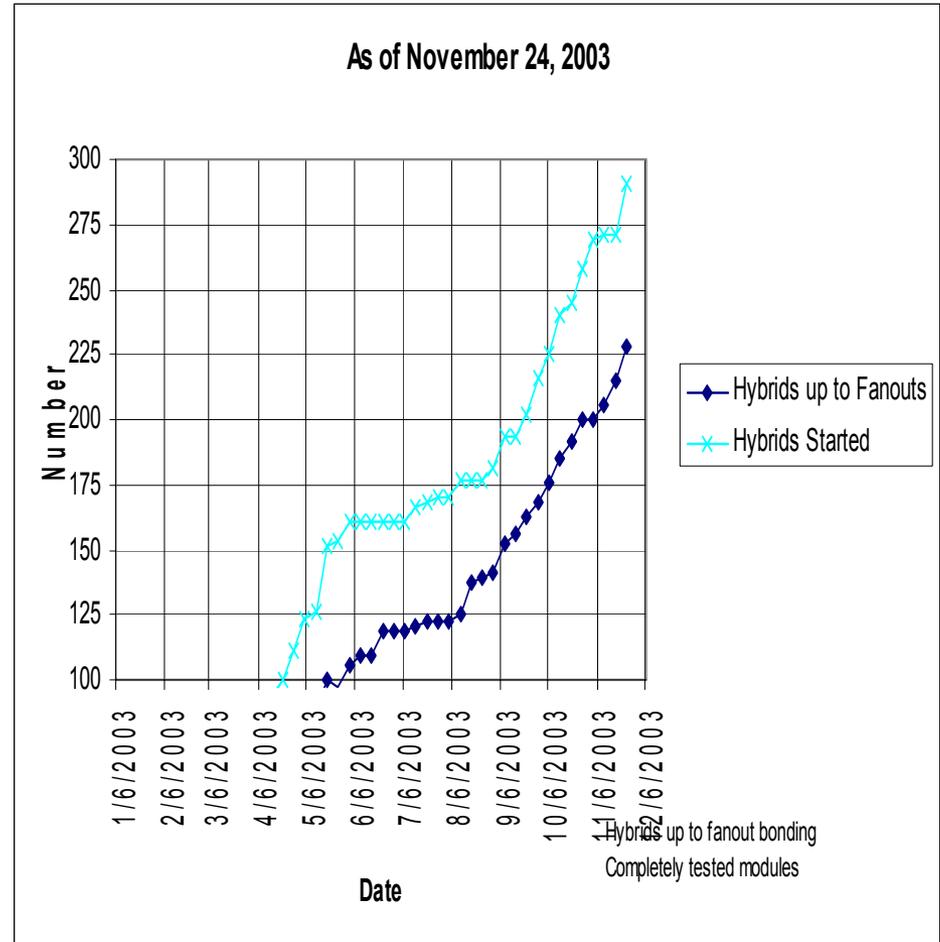
# Technical Status

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- Production started 9/02
- Qualification milestone passed 4/03
- Two metrology systems in full use.
- 2 H&K wirebonders in use. No longer using the K&S machine as the H&K works very well.
- Regularly building modules inside all specs.
- 300 modules have been started, 237 classified, 189 screened.
- Regularly align and glue 6 sides per day.
- Can align and glue 5 hybrid sides per day. Real activity has been much less due to lack of hybrids.
- Considerable effort and re-direction of resources to deal with hybrid gold metallization and PA problems.
- Can now clean gold sufficiently to use hybrids in hand. These are being used but will run out in ~1 week.
- Full 483 module deliverable complete by 6/04 assuming component flow OK.

# Hybrid Production

- Strongly coupled to deliveries and required effort on side studies (cleaning...)
- Gold metallization problem has been a big interruption since the last SCT week.
- Considerable work on cleaning aspects. Now can clean in Argon plasma, requires 6 minutes.
- Effect of Argon on PA appears bad – bond strength decreases, need to keep PA covered!!
- 291 (228) started (completed) total, 66 (52) since last SCT week.
- Release for production of low block gain hybrids crucial for maintaining production rate.



# Module Assembly and Test

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- Lingerings problems
  - Re-alignments due to shifts or drifts during assembly which are time consuming
  - Handling issues, occasional damage in fixture operations
- Issues
  - Use of lower grade detectors – some are worse than modules already on hold. Implies these (old) holds should now be considered PASS.

# Status

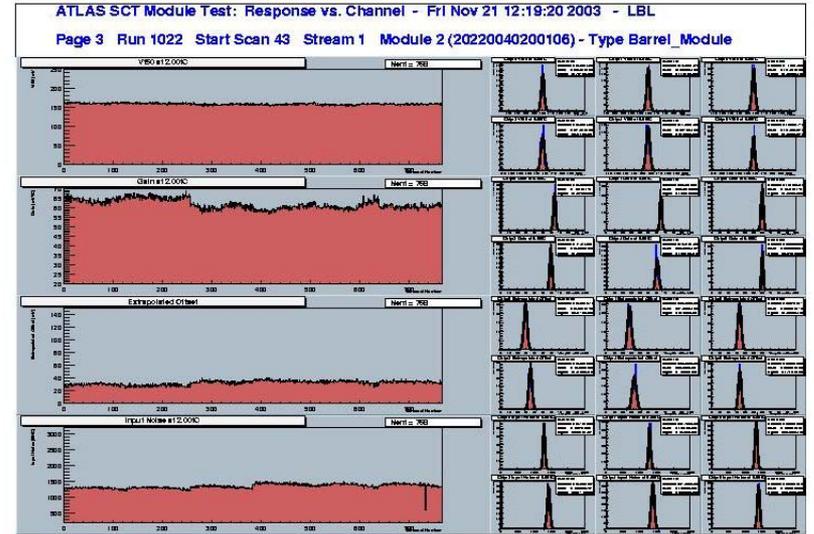
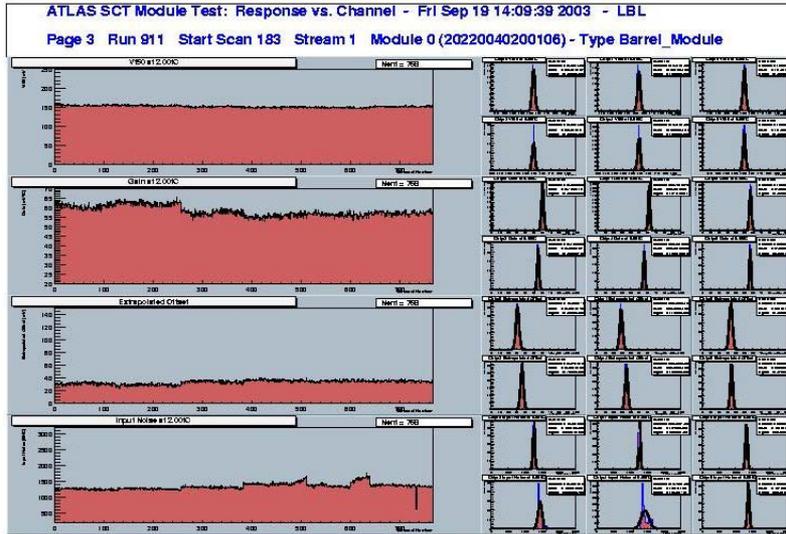
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- 189 Modules Completed (tested)
- 162 Pass all electrical tests (GOOD)
- 13 with noisy channels (see next slide)
- 8 Hold/Fail for leakage current
- 7 Hold for mechanical
- 3 Gone to TB/Irradiation

# Modules with block of noisy channels

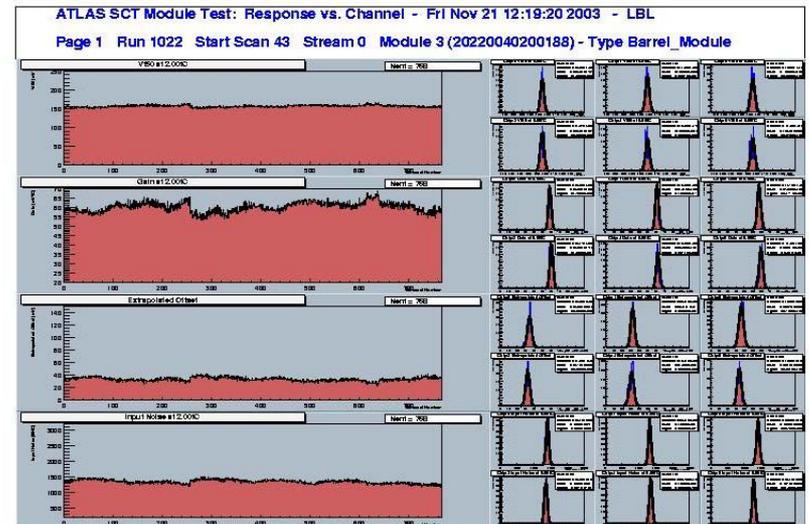
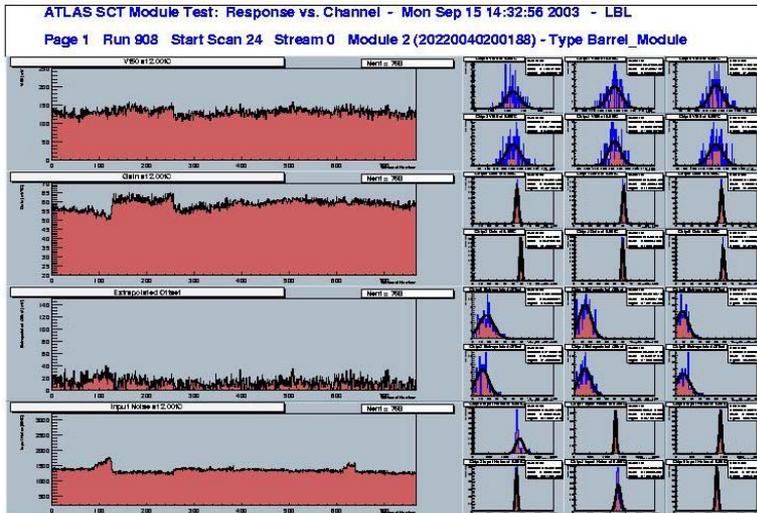
Several Modules have blocks of noisy channels that correspond to a dip in the gain in some cases. By increasing the Strobe Delay (“after” plots) the noise goes back to an uniform level (see a more detailed talk tomorrow).

106  
before



106  
after

188  
before



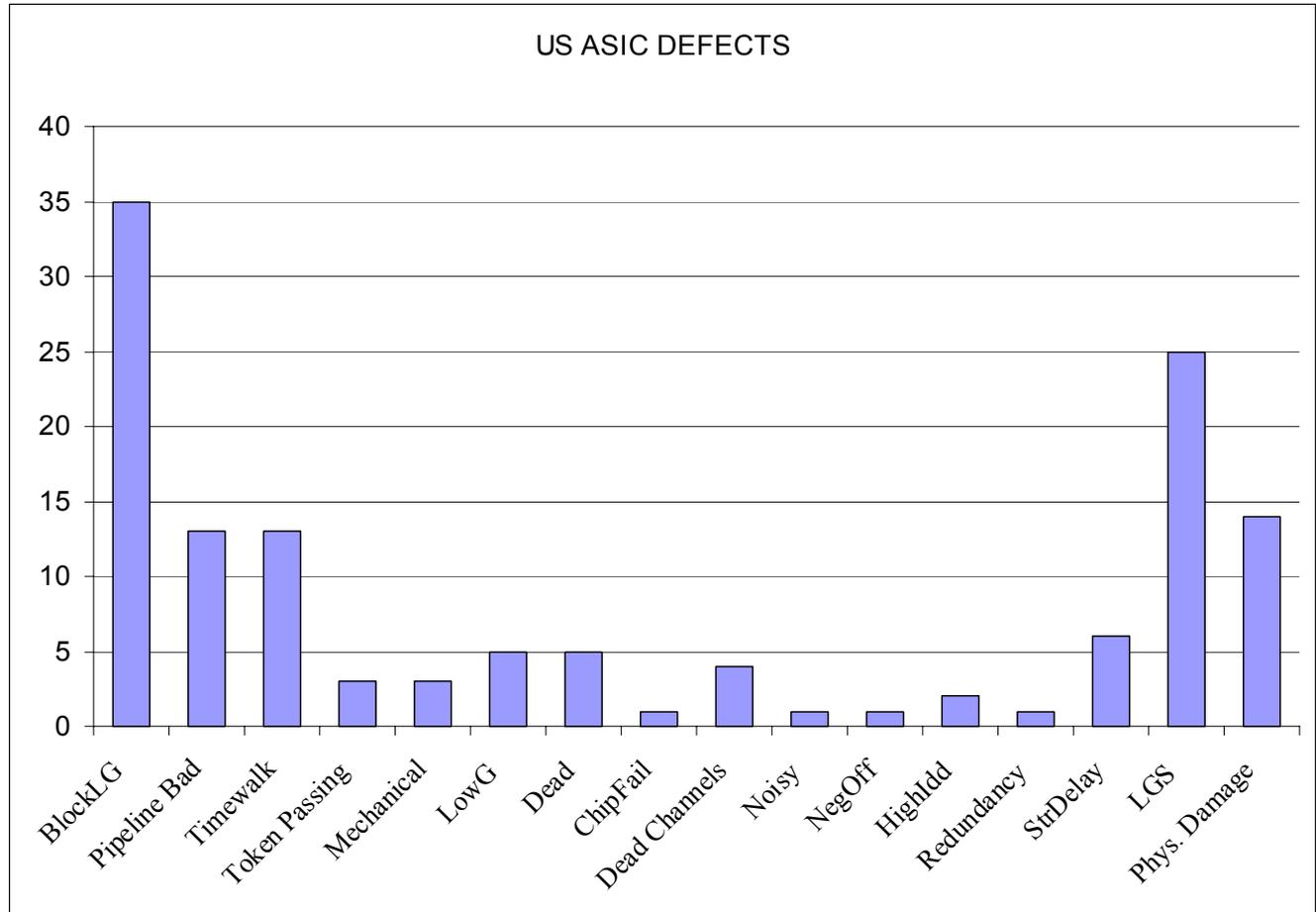
188  
after

# Defective ASIC's

LGS ok to use with ISH=20 $\mu$ A

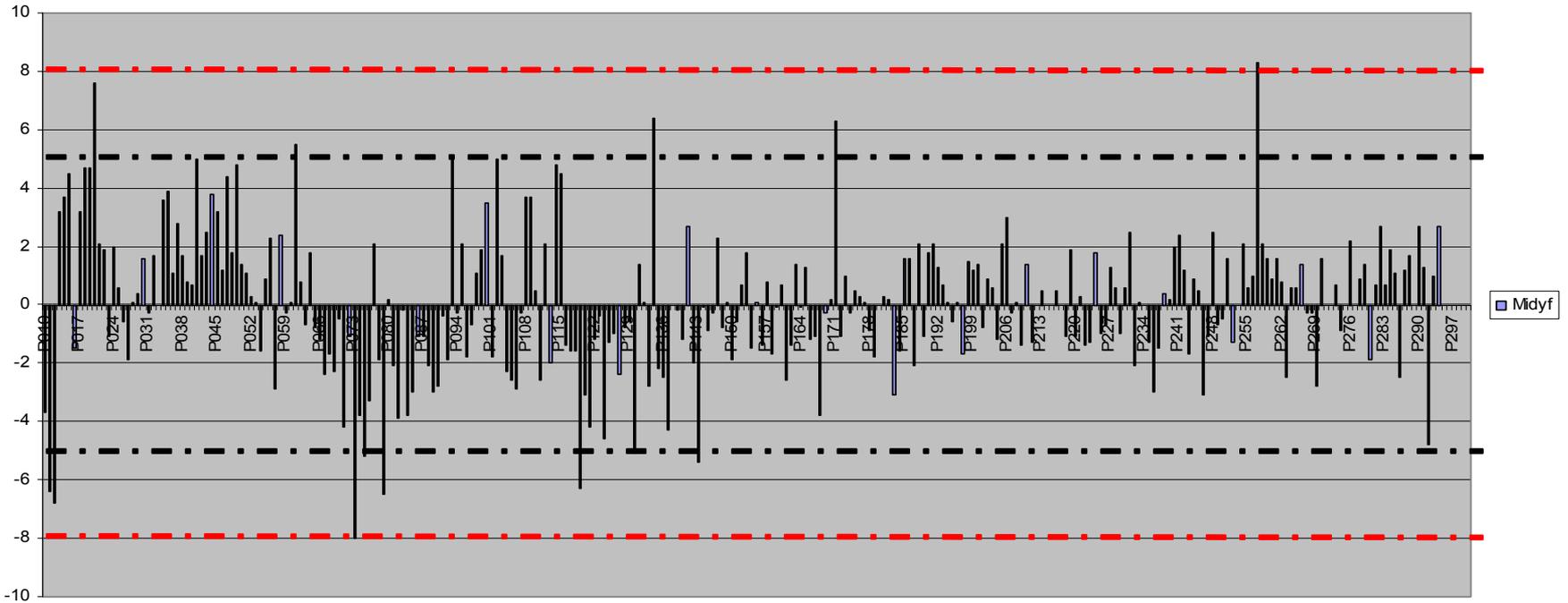
BLG (~30 hybrids on hold)  
curable with bigger SD

ASIC's replaced = 65



# Metrology: Midyf history

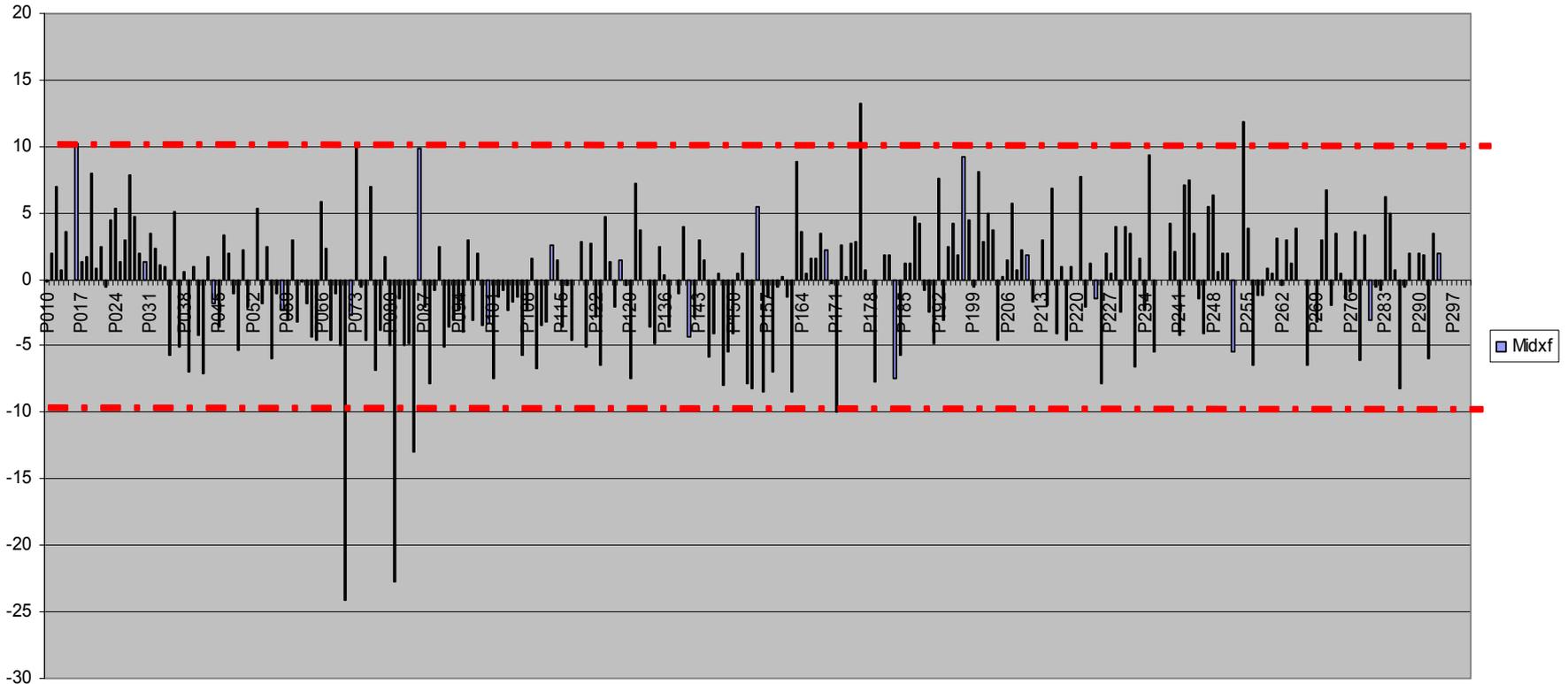
Midyf



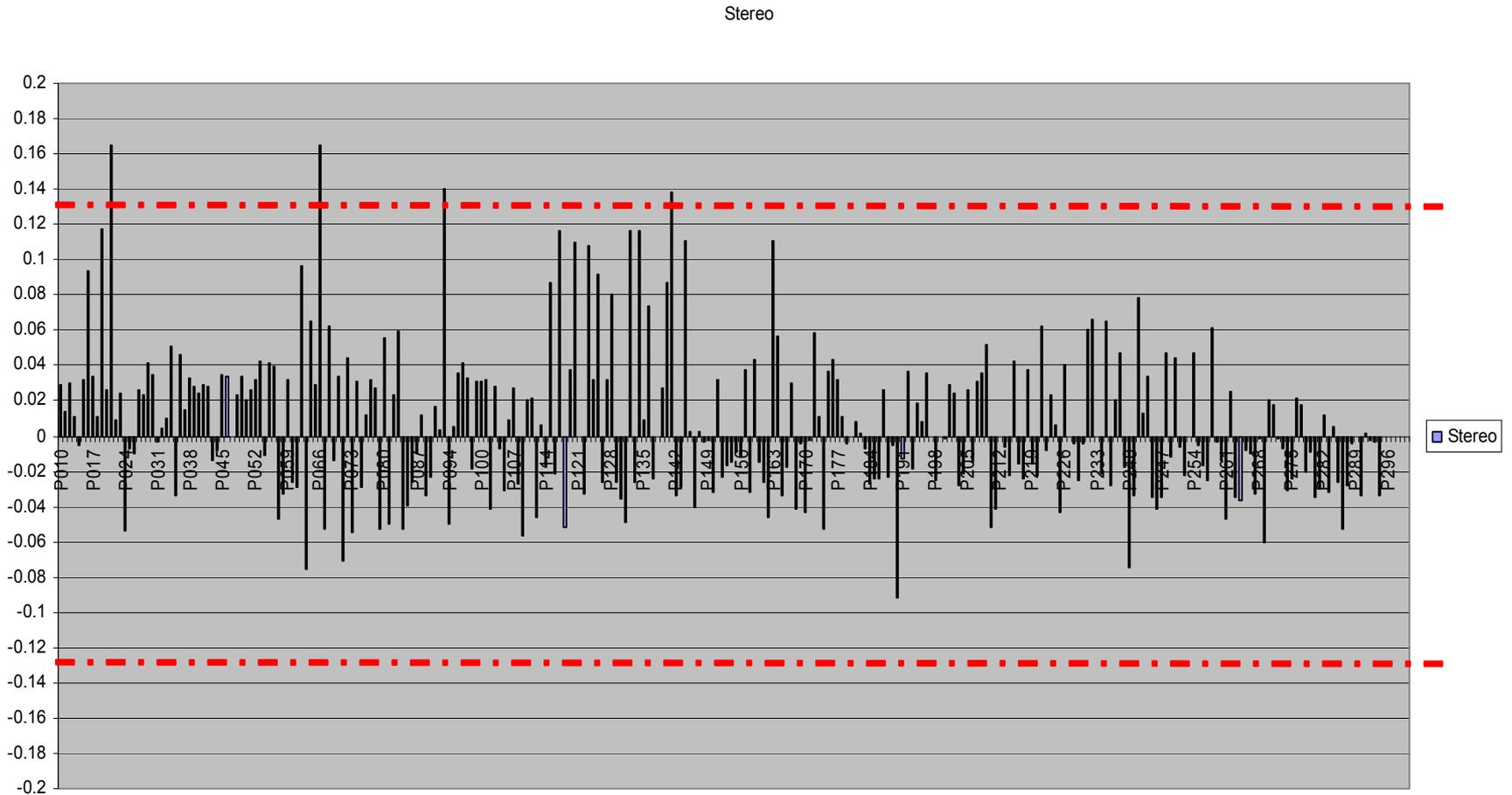
Plot shows history since 11/02

# Midxf (10 $\mu\text{m}$ )

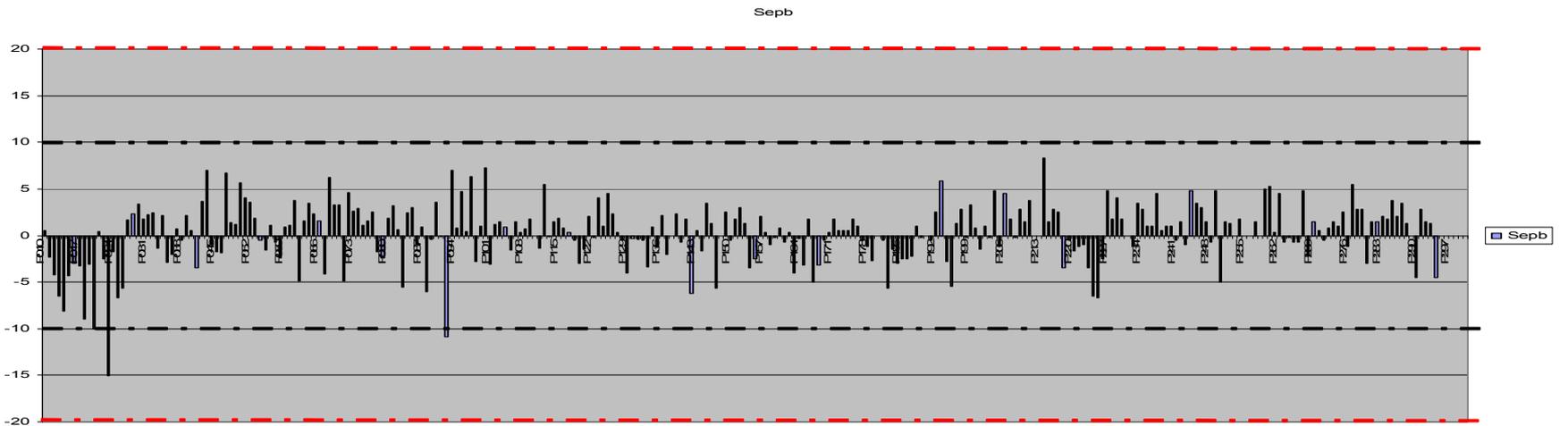
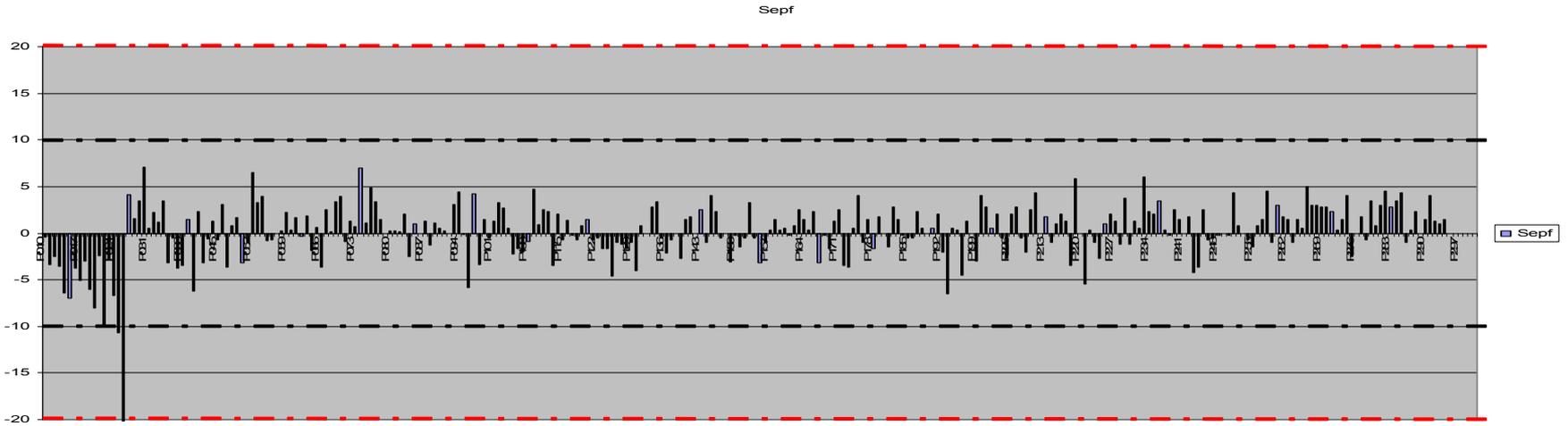
Midxf



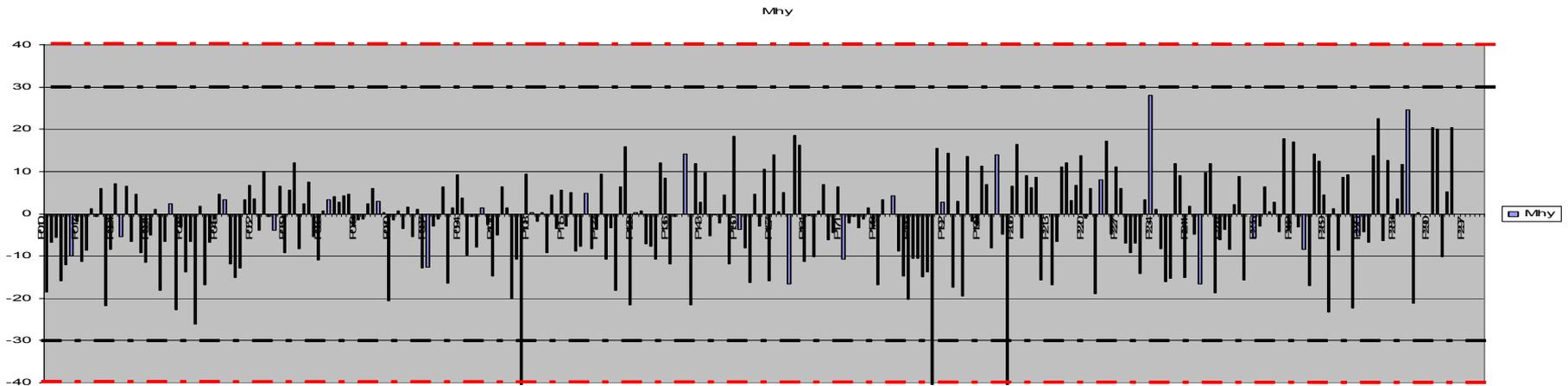
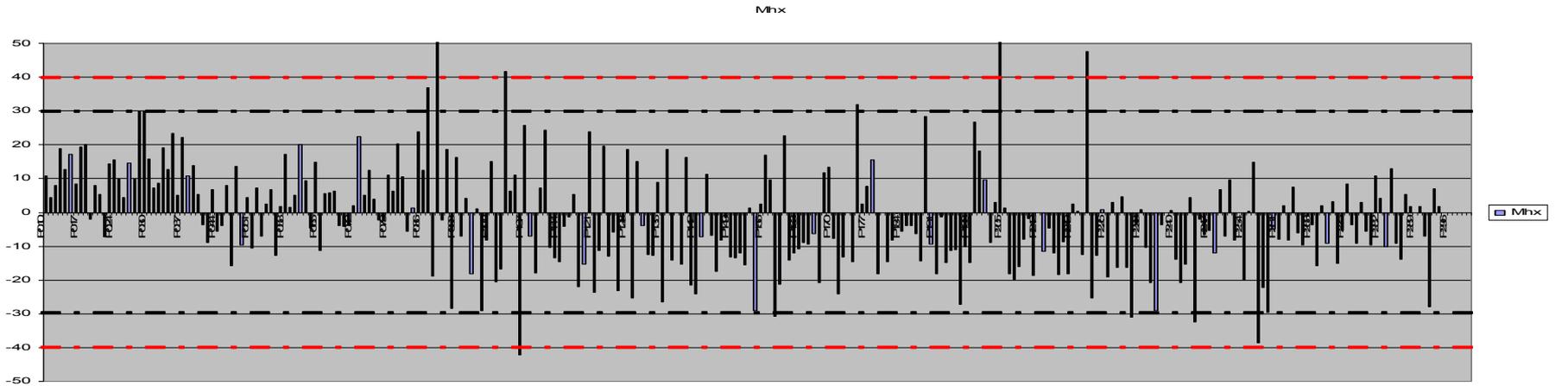
# Stereo Angle (130 mrad)



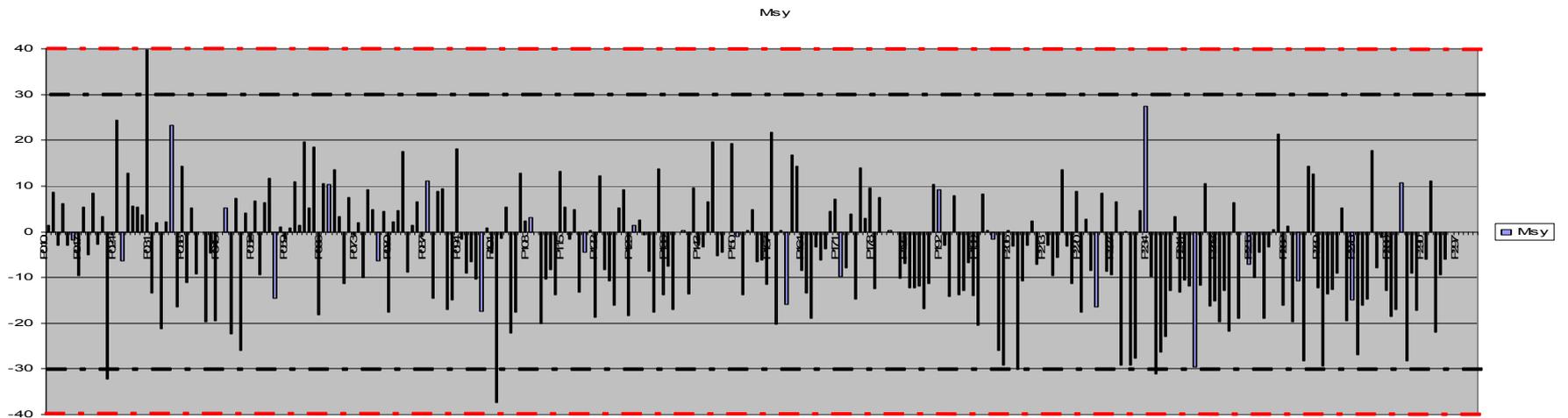
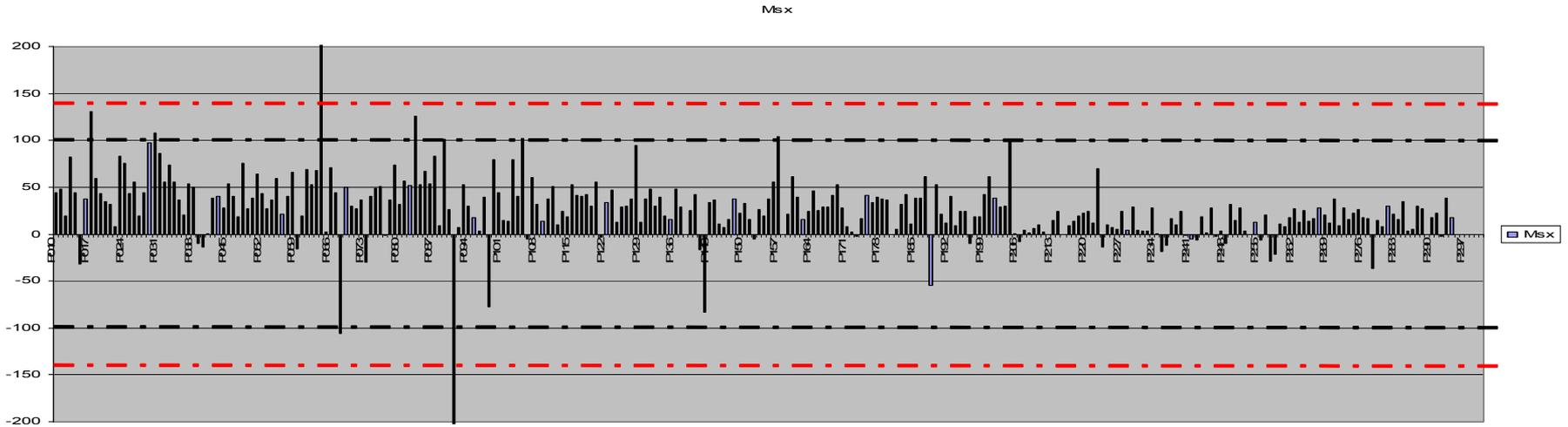
# Sepf and Sepb (10 $\mu\text{m}$ )



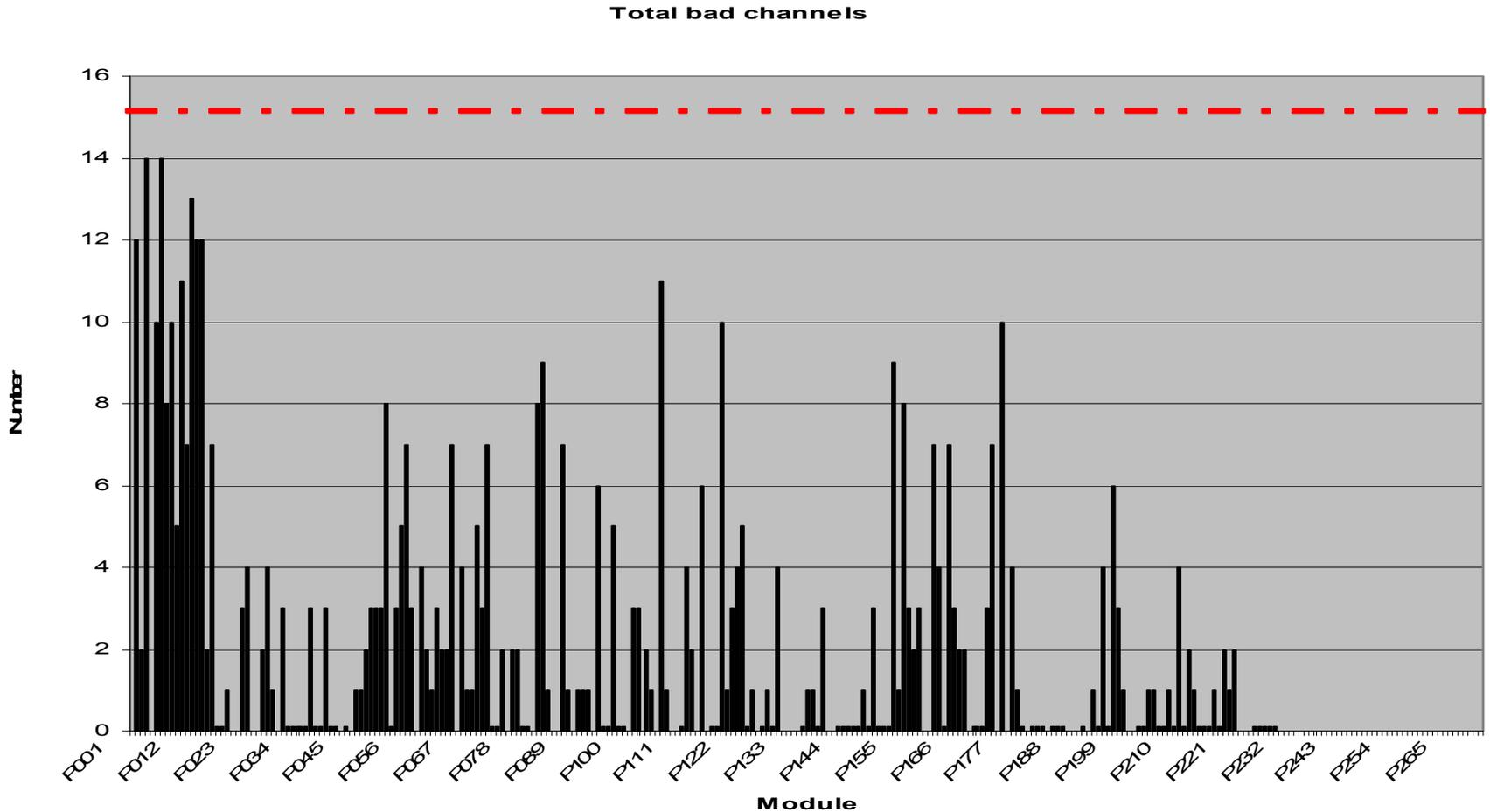
# Hole



# Slot

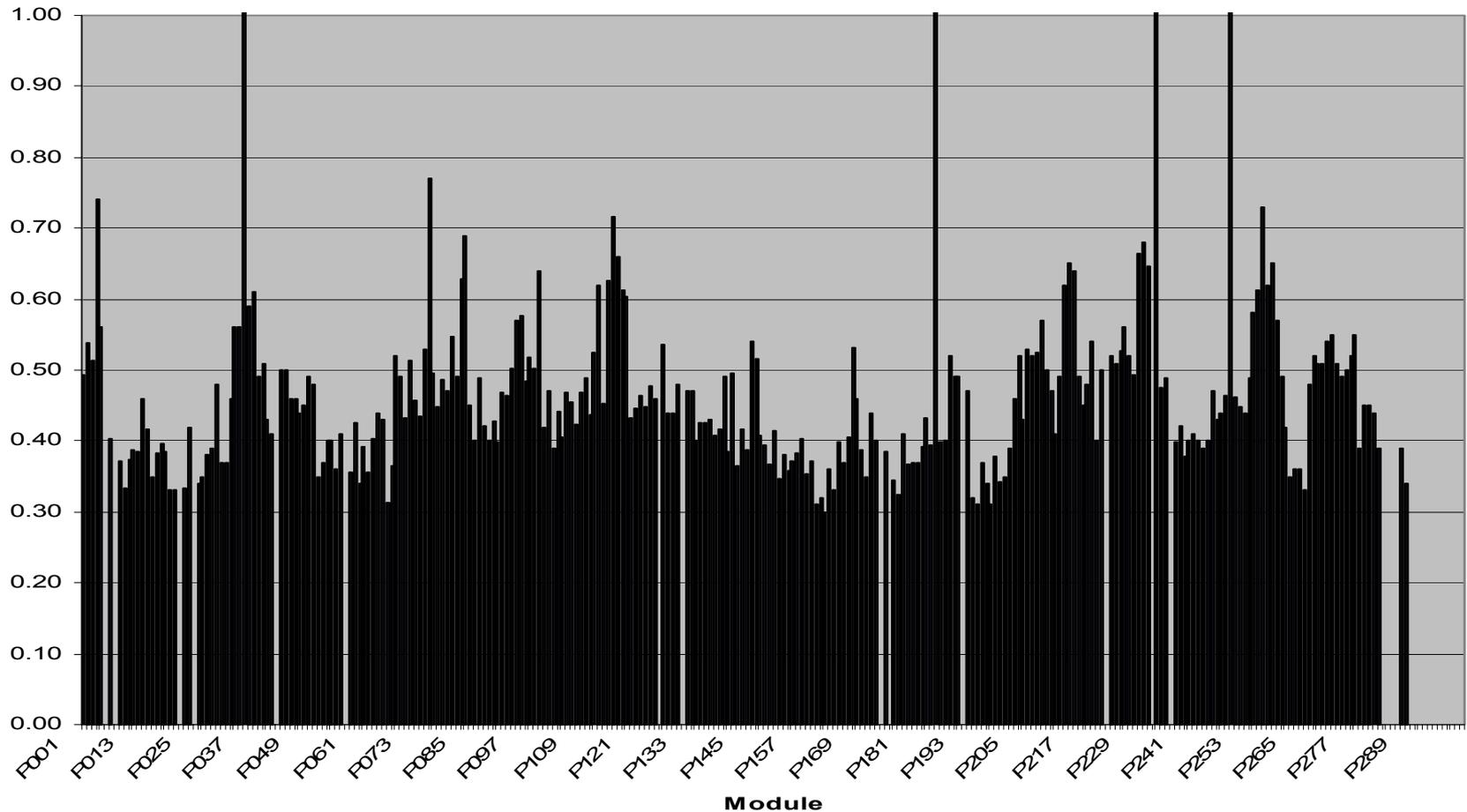


# Bad Channels per Module



# Leakage Current of 4 Wafers

I of 4 detectors in microamps @ 500V at about 20C

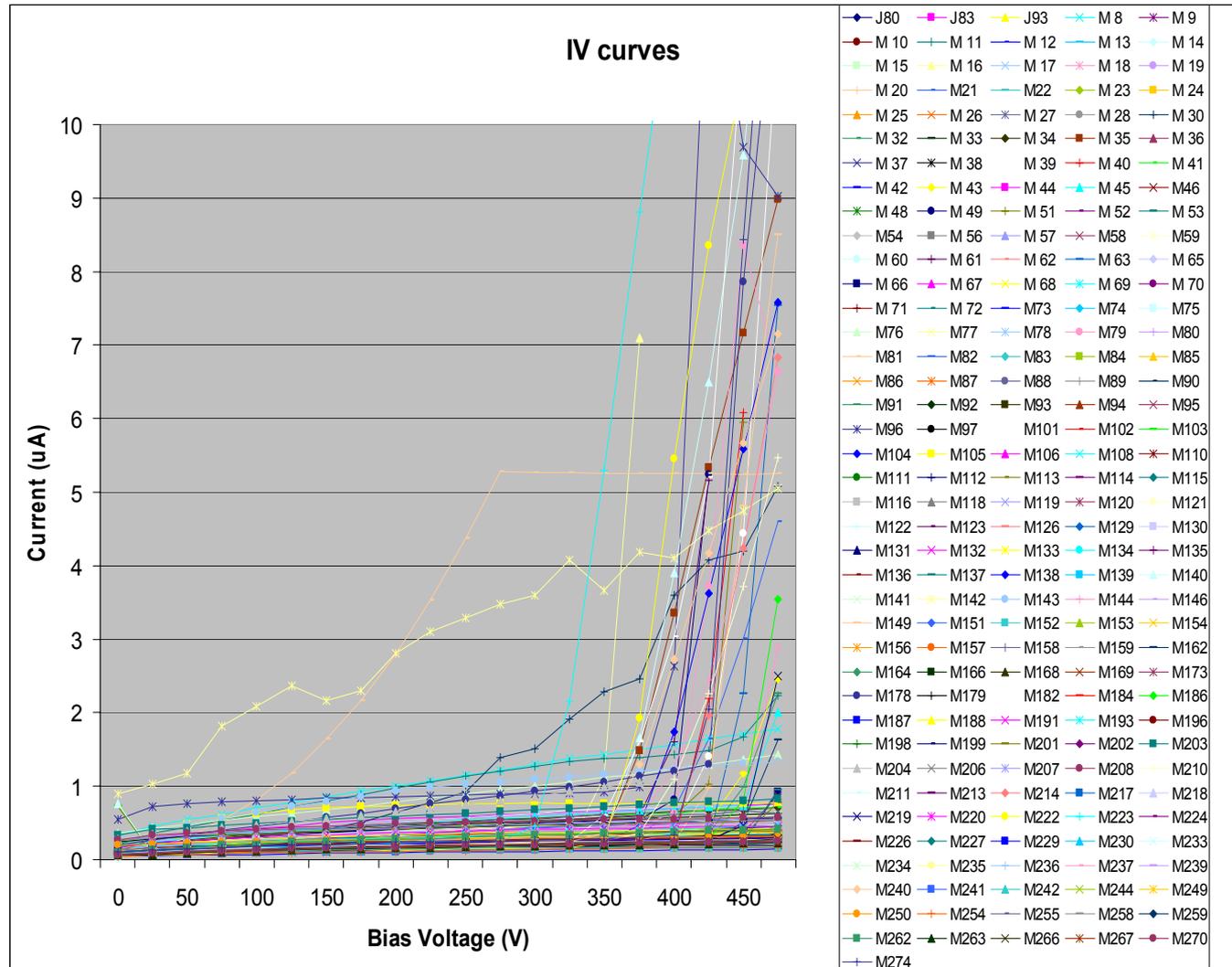


# Leakage Current

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- About 7% of individual detectors show breakdown above 350V after 4 wafer assembly.
- Except for a few, these exhibit rapid training/conditioning in seconds to few minutes after 500V.
- About 10% of modules also show breakdown above 350V just after wire bonding.
- Again most of these, exhibit rapid training/conditioning to stable, low currents.
- Correlation between breakdown at 4-wafer stage and after wire bonding to hybrid is only about 50%.

# IV Curves After bonding



# Module Categories

- We both classify modules as they are in the pipeline(as we go) and after tests are complete(or if they go to Hold, Fail, Rework). The yields are given for both all modules started and those completed tested/classified
- As of November 24.
- Modules started: 300. “Pipeline yield”
  - Modules Good finished or in pipeline:203(68%)
  - Modules Good+Pass finished or in pipeline:243(81%)
  - Modules Good+Pass+Hold finished or in pipeline:288(96%)
  - Modules Good+Pass+Hold+Rework finished or in pipeline:293(98%)
- Modules classified(tests done + Hold, Fail, Rework): 237. “Classified yield”
  - Modules Good: 143(60%)
  - Modules Good+Pass: 180(76%)
  - Modules Good+Pass+Hold: 225(95%)
  - Modules Good+Pass+Hold+Rework: 230(97%)
- Assembled modules with all tests done: 189

# Hold Categories

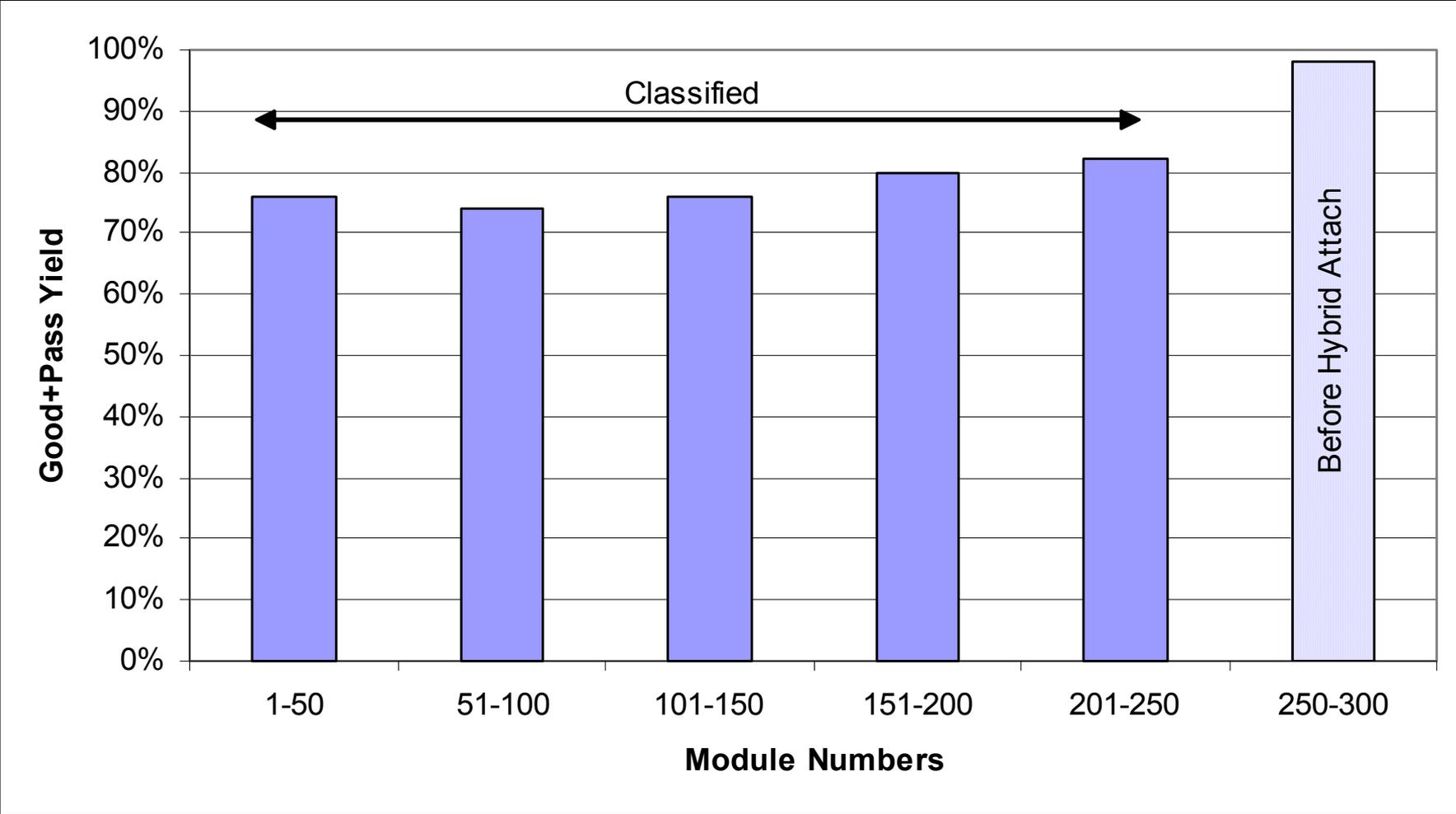
- Metrology: 17 with parameters outside PASS
  - Module thickness – one case
  - Stereo: 0.168, 0.165, 0.165,0.135,0.138
  - Sepf -23
  - Midxf: -24,-23,-13,11.9
  - Mhx,y: 59, 42, -42, 64,44,88
  - This problem is largely solved, hold rate much lower in last 50 modules
- Leakage current  $IV > 4 \mu\text{A}$  w/o MD < 350V: 6
- Leakage glue: 8
  - 4 only in gap or minimal
  - 4 with glue on surface but not on pads
  - Most of these occurred early, rate now is ~once every hundred modules. May be due to shim round-off error.
- Other: ~5 have slight mechanical damage on PA or on edge of silicon but otherwise perform well.

# Fail and Rework Categories

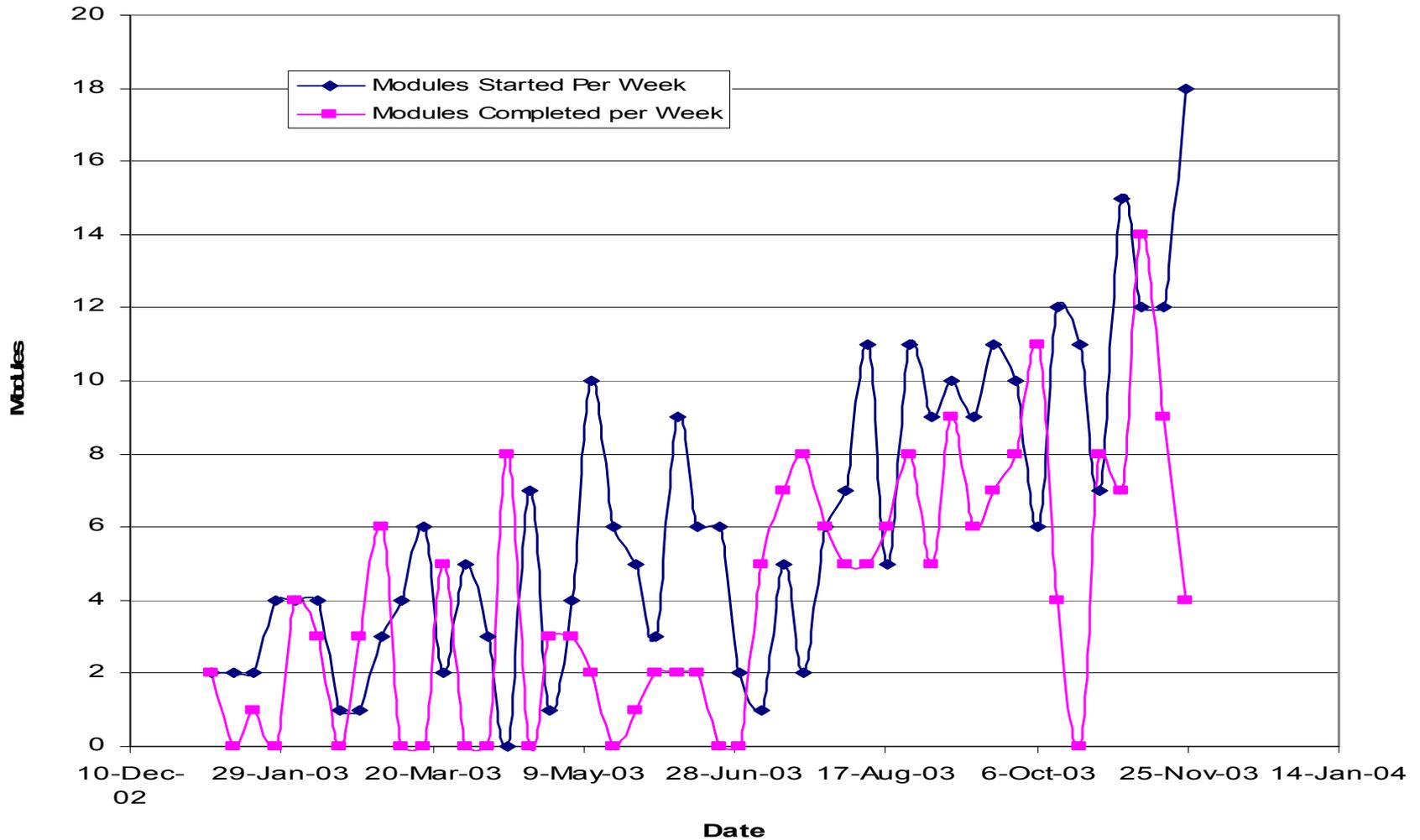
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- Metrology: 2
  - Completely off due to wrong DIMS file
  - Vacuum failure during cure
- Broken or damaged: 5
  - Accidents
- Reworks: 5
  - 3 are hybrids too high
    - Have fixed one so far with hot wire to cut glue under foot
    - Expect to repair others eventually
  - 2 are bond damage
    - Expect to repair with some add'n bad channel or leakage

# Module Yields

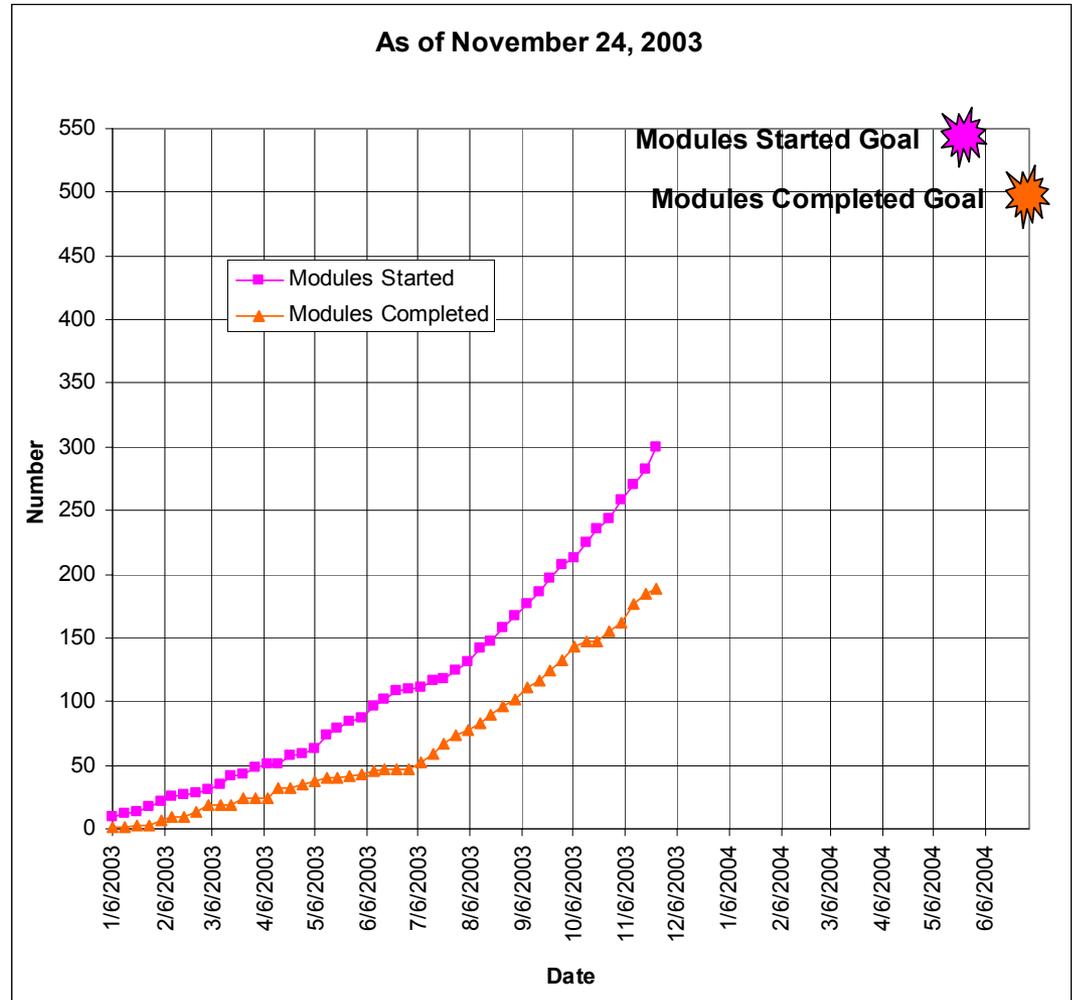


# Modules per week



# Production Model

- Based upon deliverable of 483 modules
- Based upon current rate, increasing to  $>2/\text{day}$  later in the project
- Include measured delay between assembly and test completion
- Project ends 6/04



# Conclusion

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- Running well below capacity for hybrids
  - Decide on “block low gain” (hopefully release) this week. Release would keep us going until Christmas.
  - Need schedule projection.
- Currently projecting 550 module starts by mid-April 2004 (assuming availability of detectors).
- If hybrids available in time, project completion of module assembly/test by June '04
- Yield better, will keep trying to improve